SYMPOSIUM:
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TITLE:
"An Object-oriented Interface to the CCSDS Ground Telecommand Services"

ABSTRACT:

The Telecomand Data Routing and Channel Services defined by the Consultative Committee for Space Data Systems (CCSDS) are flexible enough to support a myriad of commanding models. Because the standard is so broad, the traditional approach has been to implement only the portion of the standard needed by the particular spacecraft being tested/operated.

Tasked with providing Telecommand Services for an entire class of spacecraft, where each spacecraft may choose any valid CCSDS commanding model, NASA Code 584 designed a common architecture capable of handling the full CCSDS protocol.

The solution uses another CCSDS standard - the Standard Formatted Data Unit (SFDU) as the interface to the Telecommand Services. SFDUs provide a consistent way of labelling data objects, as well as allowing data objects to encapsulate other data objects. The resulting interface is:

- Flexible: The full Data Routing and Channel Services are available via a single interface. The client (i.e. the command source) may enter commands at any layer within the protocol stack, specify any of the data aggregation or segmentation methods, and dynamically set any configuration parameter defined in the standard.

- Object-oriented: Each object specifies both the data and the actions to be performed with the data. An object may contain other objects.

- Expandable: New capabilities are added by defining new objects. Objects pass thru the protocol layers until they reach the applicable layer.

The resulting design is:

- Modular: The logic for each protocol layer is contained in a separate Application Program Interface (API). The objects used for the external interface are also used for communication between layers.

- Distributable: The design can be split along any layer boundary for distribution across multiple machines. The objects ensure data consistency across platforms.

This paper describes the SFDU-based interface and the resulting protocol implementation. The implementation is currently used by NASA (National Aeronautics and Space Administration) for integration & test of the Microwave Anisotropy Probe (MAP) and Earth Observer-1 (EO-1) spacecraft. It will be used for post-launch operations of these spacecraft as well as the Imager for Magnetopause to Aurora Global Exploration (IMAGE) spacecraft.

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